WHAT IS CLAIMED IS:

1	1. A polarization-insensitive integrated wavelength converter comprising
2	a wavelength converter having first and second input/output ports;
3	a polarization separator having a first port for receiving an input optical signa
4	a second port providing a first component of the input optical signal in a first polarization
5	mode, and a third port providing a second component of the input optical signal in a second
6	polarization mode, with the second port of the polarization separator optically coupled to the
7	first input/output port of the wavelength converter; and
8	a polarization rotator coupling the third port of the polarization separator to the
9	second input/output port of the wavelength converter that rotates the polarization mode of an
10	optical signal propagating through the polarization rotator.
1	2. The apparatus of claim 1 wherein said polarization rotator comprises
2	an electro-optic half-wave retarder;
۷	an electro-optic nan-wave retaider,
1	3. The apparatus of claim 1 wherein said polarization rotator comprises a
2	half-wave plate;
1	The amounting of claims 2 forther including a hout wave quide.
1	4. The apparatus of claim 2 further including a bent waveguide;
1	5. The apparatus of claim 1 wherein said polarization rotator comprises
2	an electro-optic quarter-wave retarder.
1	6. The apparatus of claim 1 wherein said polarization rotator comprises a
2	quarter-wave plate.
1	7. The apparatus of claim 4 further including a mirror.
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1	8. The apparatus of claim 1 wherein said polarization rotator comprises
2	an optical fiber having a 90° twist to change the polarization mode.
1	9. The apparatus of claim 1 wherein said polarization rotator comprises:
2	a plurality of light signal propagating paths;
3	wherein said wavelength converter comprises:
4	a plurality of processing channels, each having a second input/output port
5	coupled to a respective light signal propagating path; and

wherein said polarizing beam splitter comprises:
a plurality of channels coupling the processing channels and light signal
propagating paths.
10. The apparatus of claim 1 wherein at least a portion of said wavelength
converter comprises a quasi-phasematched structure.
11. The apparatus of claim 10 wherein at least a portion of said quasi-
phasematched structure is incorporated in lithium niobate.
12. The apparatus of claim 10 wherein at least a portion of said quasi-
11
phasematched structure is incorporated in magnesium-oxide-doped lithium niobate.
13. The apparatus of claim 10 wherein at least a portion of said quasi-
phasematched structure is incorporated in lithium tantalate.
14. The apparatus of claim 10 wherein at least a portion of said quasi-
phasematched structure is incorporated in magnesium-oxide-doped lithium tantalate.
15. The apparatus of claim 1 further comprising a waveguide structure.
16. The apparatus of claim 15 further wherein said waveguide structure
includes a proton-exchanged waveguide.
, and the second
17. The apparatus of claim 15 further wherein said waveguide structure
includes an annealed-proton-exchanged waveguide.
18. The apparatus of claim 15 further wherein said waveguide structure
11
includes a zinc-diffused waveguide.
19. The apparatus of claim 15 further wherein said waveguide structure
includes a metal-diffused waveguide.
20. The apparatus of claim 15 further wherein said waveguide structure
includes a titanium-diffused waveguide.
21. The apparatus of claim 15 further wherein said waveguide structure
includes a buried waveguide.

1	22.	The apparatus of claim 15 further wherein said waveguide structure
2	includes a reverse-p	roton-exchange waveguide.
1	23.	The apparatus of claim 1 further comprising an optical circulator
2	having a port couple	d to the first port of the polarizing beam splitter.
1	24.	The emperature of claims 1 for their communicians are electric anti-culture.
1 2		The apparatus of claim 1 further comprising an electro-optic phase ying the phase of at least one of the components of the optical signal.
۷	modulator for modif	ying the phase of at least one of the components of the optical signal.
1	25.	The apparatus of claim 1 further comprising an electro-optic phase
2	modulator for modif	ying the phase of at least one of the components of the optical signal.
1	26.	The apparatus of claim 1 wherein input optical signal comprises a
2	plurality of optical s	ignals.
1	_D 27.	A polarization-insensitive integrated wavelength converter comprising
2	•	relength converter substrate;
3		rization separator serving to separate an input optical signal into first and
4		onents having orthogonal polarization modes.
5		arization rotator serving to rotate the polarization mode of at least one of
6	said first and second	
7		relength converter structure for receiving said signal components and
8	generating converted	
1	28.	The apparatus of claim 27 in which said converted signal components
2	comprise a frequency	y-converted input signal.
1	29.	The apparatus of claim 27 in which said converted signal components
2	comprise an amplifie	ed input signal.
1	30.	The apparatus of claim 27 in which said input signal includes a pump
2	signal.	
	21	
1	31.	The apparatus of claim 27 in which said converted signal components
2	include a free	uency-doubled pump signal.
1	32	The apparatus of claim 27 further comprising

2	an optical enculator structure for providing isolation between the
3	converted signal and an input signal source.
1	33. The apparatus of claim 32 wherein said circulator further comprises
2	a first port coupled to said input signal source for receiving said input optical
3	signal, a second port coupled to said polarization separator, and a third port for providing
4	converted signal.
1	33b. The apparatus of claim 32 wherein said circulator is integrated into
2	said wavelength converter substrate.
1	34. The apparatus of claim 27 further comprising an input port for
2	receiving and transmitting one or more input optical signals.
1	
1	35. The apparatus of claim 27 wherein said polarization separator includes
2	a first port for receiving said input optical signal, a second port for transmitting a first
3	component of said input optical signal in a first polarization mode, and a third port for
4	transmitting a second component of said input optical signal in a second polarization mode.
1	36. The apparatus of claim 27 wherein said polarization rotator includes a
2	coupler for providing coupling between said polarization separator and said wavelength
3	converter structure.
1	3 37. A polarization-insensitive integrated wavelength converter comprising:
2	a wavelength converter substrate;
3	a first waveguide, formed in said substrate, capable of supporting both TM and
4	TE polarization modes and having first and second input/output ports;
5	a second waveguide, formed in said substrate, capable of supporting at least
6	one of TM and TE polarization modes and having first and second coupling sections disposed
7	near said first waveguide to evanescently couple light signals between said first waveguide
8	and said second waveguide;
9	a reflector coupled to the second input/output port of said second waveguide;
10	a polarization rotator region disposed between the first and second coupling
11	sections;
12	a wavelength converter region formed in at least one of the first waveguide
13	and second waveguide; and

14	a co	oupler serving to couple said wavelength converter region to said
15	polarization rotator	r region.
1	y 38.	A polarization-insensitive integrated wavelength converter comprising:
2	•	onverter substrate;
3	a fii	rst waveguide, formed in the substrate, having first and second
4	input/output;	
5	a se	cond waveguide, formed in the substrate, having first and second coupling
6	sections to evaneso	cently couple light signals between the first waveguide and the second
7	waveguide (suppor	rting only TE polarization modes);
8	a po	plarization rotator region disposed on the first waveguide (between the
9	second coupling se	ection and the second input/output port of first waveguide);
10	a re	flector coupled to the second input/output port of the first waveguide; and
11		a wavelength converting structure formed in at least one of the first
12	waveguide	and second waveguide.
1	39.	The apparatus of claim 38 wherein said first waveguide is capable of
2		optical signals having both TE and TM polarization modes.
1	40.	The apparatus of claim 38 wherein said first waveguide includes a
2	metal wave	guide.
1	.41.	The apparatus of claim 38 wherein said first waveguide includes a
2	buried wave	eguide.
1	42.	The apparatus of claim 38 wherein said first waveguide includes a
2	diffused wa	-
_	diffused wa	regulae.
1	43.	The apparatus of claim 38 wherein said first waveguide includes a Zinc
2	waveguide.	
1	44.	The apparatus of claim 38 wherein said first waveguide includes a
2	Titanium w	
1	45.	The apparatus of claim 38 wherein said second waveguide includes a
2		-
4	proton-excr	nanged waveguide.

l	46.	The apparatus of claim 38 wherein said second waveguide includes an
2	annealed- pro	oton-exchanged waveguide.
1	47.	The apparatus of claim 38 wherein said second waveguide includes a
2	buried waveg	guide.
1	48.	The apparatus of claim 38 wherein said polarization rotator includes a
2		The apparatus of claim 36 wherein said polarization folator includes a
2	wave plate.	
1	49.	The apparatus of claim 38 wherein said polarization rotator includes a
2	quarter-wave	plate.
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1	50.	The apparatus of claim 38 wherein said polarization rotator includes a
2	half-wave pla	ate.
1	51	
1	51.	The apparatus of claim 38 wherein said polarization rotator includes an
2	electro-optic	wave plate.
1	52.	The apparatus of claim 38 wherein said polarization rotator is
2	positioned near said	-
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1	53.	The apparatus of claim 38 wherein said polarization rotator is
2	positioned near first	waveguide between said first coupling section and said second coupling
3	section.	
á		
1	54.	The apparatus of claim 38 wherein said polarization rotator is
2	positioned near first	waveguide between said second coupling section and said reflector.
1	55.	The apparatus of claim 38 wherein said polarization rotator includes a
2		nto a saw cut in said converter substrate.
_	waveplate inserted if	tio a saw cut in said converter substrate.
1	56.	The apparatus of claim 38 wherein said polarization rotator includes a
2	waveplate fastened to	o the end of said converter substrate.
1	57.	The apparatus of claim 38 wherein said polarization rotator includes a
2	waveplate fas	stened between the end of said converter substrate and said reflector.

1	:	58.	The apparatus of claim 38 wherein said reflector serves to reflect said
2	input signals.		
1	:	59.	The apparatus of claim 38 wherein said reflector serves to reflect said
2	converted signa	ıls.	
1	(60.	The apparatus of claim 38 wherein said reflector serves to reflect pump
2	signals.		
1		~1	
1		61.	The apparatus of claim 38 wherein said reflector serves to transmit
2	frequency-doub	oled pu	mp signals.
1		62.	The apparatus of claim 38 wherein said reflector serves to reflect
2	frequency-doub	nea pu	mp signais.
1		63.	The apparatus of claim 38 wherein said reflector serves to transmit said
2	input signals.		
-	input oignaio.		
1		64.	The apparatus of claim 38 wherein said reflector serves to transmit said
2	converted signa	ıls.	
	C		
1	e	55.	The apparatus of claim 38 wherein said reflector serves to transmit
2	pump signals.		
1	6	56.	The apparatus of claim 38 wherein said wavelength converting
2	structure include	es a fe	rroelectric crystal.
1	6	57.	The apparatus of claim 38 wherein said wavelength converting
2	structure	e inclu	des a periodically-poled ferroelectric crystal capable of performing
3	quasi-ph	nasema	tching.
1	6	58.	The apparatus of claim 38 wherein said wavelength converting
2	structure	e inclu	des lithium niobate.
1		(0	The apparents of claim 20 subscain and asset asset asset as
1		59. · .	The apparatus of claim 38 wherein said wavelength converting
2	structure	e inclu	des magnesium-doped lithium niobate.

1	70.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des congruent lithium niobate.
1	71.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des stoichiometric lithium niobate.
1	72.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des lithium tantalate.
1	73.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des magnesium-doped lithium tantalate.
1	74.	The apparatus of claim 38 wherein said wavelength converting
2		des congruent lithium tantalate.
_	Structure mora	des congruent minum tantatate.
1	75.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des stoichiometric lithium tantalate.
1	76.	The apparatus of claim 38 further including an electro-optic index
2		itioned near at least one of first waveguide and second waveguide, said
3	_	ring to control the optical path length of waveguides near said
4	modulator.	
1		A polarization-insensitive integrated wavelength converter comprising:
2		length converter, having a gain level, for receiving said component
3		rating component converted signals,
4	a polari	zation separator for separating an input signal into component input
5	signals having orthogo	onal polarization modes,
6	a polari	zation rotator for rotating the polarization modes of said component
7	input signal and optica	ll signal propagating through the polarization rotator, and
8		an interchannel crosstalk modulator, comprising a detector and
9	modulator struc	cture, serving to detect levels of interchannel crosstalk between
10	wavelength-co	nverted optical signals whereby one or more of the amplitude of input
l 1	optical signals	and converter gain level are modified accordingly to reduce
12	interchannel cr	osstalk.

1	78. The apparatus of claim 77 wherein said wavelength converter includes
2	controls for modifying the gain level of at least of said converted signal, said input
3	signal and a pump signal.
1	79. The apparatus of claim 77 wherein said controls include an optical
2	parametric amplifier for providing said gain level.
1	80. The apparatus of claim 77 wherein said controls include an EDFA for
2	providing said gain level.
1	81. The apparatus of claim 77 wherein said controls include a pump diode for
2	providing said gain level.
1	82. The apparatus of claim 77 wherein said controls include a semiconductor
2	optical amplifier for providing said gain level.
1	83. The apparatus of claim 77 wherein said controls include an optical
2	attenuator.
1	84. The apparatus of claim 77 further including an optical filter structure for
2	discriminating between said input signals, said converted signals, pump signals and
3	non-converted signals.
1	85. The apparatus of claim 84 wherein said optical filter structure includes at
2	least one optical interleaver.
1	86. The apparatus of claim 84 wherein said optical filter structure includes at
2	least one arrayed waveguide.
1	9 87. A polarization-insensitive integrated wavelength converter comprising:
2	a wavelength converter having an input/output port;
3	a polarization separator having
4	a first port for receiving an input optical signal, optically
5	coupled to the input/output port of the wavelength converter,
6	a second port providing a first component of the input optical
7	signal in a first polarization mode, and

8			a third port providing a second component of the input optical
9			signal in a second polarization mode,
10			a wavelength converting structure having a first port and a second port,
11			said first port being coupled to the second port of the polarization
12			separator, serving to provide wavelength conversion on said input
13			optical signal,
14		a pola	arization rotator coupling the second port of the wavelength converting
15	structure to t	he third	port of the polarization separator, serving to rotate the polarization of the
16	said input sig	gnal.	
17	1	88.	A polarization-insensitive integrated wavelength converter comprising:
18		a pola	arization separator having two or more waveguides that support
19	orthogonal p	olarizat	ion modes of an input signal,
20		a wav	relength converting structure, serving to provide wavelength conversion
21	on said input	toptical	signal, a polarization rotator, serving to rotate the polarization of the said
22	input signal,	and a co	oupler serving to optically couple said waveguides.
1	Ç	89.	A polarization-insensitive integrated wavelength converter comprising:
2		a wav	reguide that supports an input signal having a plurality polarizations,
3		a wav	velength converting structure, serving to provide wavelength conversion
4	on at least or	ne polari	ization mode of said input optical signal, a polarization rotator, serving to
5	rotate the sai	d plural	ity of polarizations of the said input signal, and a reflector serving to
6	reflect said in	nput sig	nal back through said wavelength converting structure.
1	û	90.	A polarization-insensitive integrated wavelength converter comprising:
2		at leas	st one polarization splitter comprising a first waveguide that supports an
3	input signal l	having a	plurality polarizations, and a second waveguide that supports at least
4	one polarizat	ion mod	le of said input signal, a wavelength converting structure serving to
5	provide wave	elength	conversion on at least one polarization mode of said input optical signal,
6	and a polariz	ation ro	tator, serving to rotate the polarizations of said input signal in at least
7	one of first o	r second	l waveguides.
1	io	91.	A polarization-insensitive integrated wavelength converter comprising:
2		at leas	st one polarization splitter comprising a first waveguide that supports an
3	input signal l	naving a	plurality polarizations, and a second waveguide that supports one

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	4	polarization mode of said input signal, a wavelength converting structure, serving to provide					
	5	wavelength conversion on at least one polarization mode of said input optical signal, and a					
	6	lens, wave plate and reflector assembly serving to optically couple said first and second					
	7	waveguides.					
	1	92. The apparatus of claim 91 wherein said wavelength conversion					
	2	structure further comprises an optical frequency synthesizer, serving to provide frequency					
	3	translation on said input signals.					
	1 2 3 4	93. A polarization-insensitive integrated wavelength converter comprising: an optical circulator; a substrate; a waveguide, formed in said substrate, capable of supporting both TM and TE					
	5	polarization modes and having first and second input/output ports;					
<u>.</u>	6	a polarization rotator region disposed at the second input/output port;					
	7	a reflector coupled to said polarization rotator region; and a wavelength					
,	8	converter region formed in the waveguide.					
than 13" trust than that that the	1 2 3	94. A polarization-insensitive integrated wavelength converter comprising: a substrate; a waveguide, formed in said substrate, capable of supporting both TM and TE					
Ļ	4	polarization modes and having first and second input/output ports;					
.	5	a polarization rotator region disposed at the second input/output port;					
	6	a reflector coupled to said polarization rotator region; and a wavelength					
dead the	7	converter region formed in the waveguide.					
a	1	•					